Patent Application of

Jason L. Smith

For

PRESSURIZED FLUID CONTROLLER USING TILT / PUSH / PULL OPERATOR

Background -Field of Invention

This invention provides a pressure selector valve including a lever operator which is capable of broader (more) controlling functions than current joy stick pressure valve controllers. While the invention has indeed a wide utility controlling pneumatic and hydraulic machine functions, it is well suited to controlling pitch, roll, and elevation of heavy equipment needing precision positioning. One example of these applications includes docking of robot machines and circuit board testing fixtures in the industry of semiconductor manufacturing equipment.

Another application example is precise positioning of heavy leaded glass windows and moving radiation shielded doors within a nuclear facility.

Another application example is elevation and tilting control of heavy manufactured products (such as military tanks or motor homes) at various process stations along a factory production line.

Background-Description of Prior Art

Current joy stick controllers such as that disclosed in U.S. Patent Nos. 4,404,991 granted to Cullen Sep. 20, 1983; and 4,296,773 granted to Harshman and Dietrich Oct. 27, 1981, use a lever and attached circular cam to selectively activate four valves arranged in one array (oriented axially to and circularly around the lever). A limitation of these joy stick controllers are that the single four valve array has limited machine control utility. For example, if these joy stick controllers

were plumbed to four air bags supporting a robot, they could only control robotic tilt (pitch and roll). Additional valve control for elevation is missing.

Because pressure joy stick controllers have functional limitations, some industries do not use them at all or use them in concert with additional valves or switches thus adding to the system complexity and loss of some intuitive understanding. For example, the semiconductor industry (for precision robot docking) uses an electric joy stick controller such as that disclosed in U.S. Patent Nos. 5,042,314 granted to Rytter, Boucher, and Kelley Aug. 27, 1991; and 4,812,802 granted to Watanabe Mar. 14, 1989, to control electric motor driven ball jacking (lifting) screws to control all three functions pitch, roll and elevation. This electric system has serious limitations for the industry. The electric jack screw actuators are very expensive, heavy, and complex. Also the jack screws are about a foot high, can not fit under the robot structure, and must be bracket mounted to the outside the robot significantly increasing the robot area footprint.

This invention solves the limitations of the electric jack screw robot docking application above. The invention provides a means to use only pneumatic controls and actuators (air bags for example) with advantages of low cost, light weight, and intuitive simplicity. The invention pneumatic system components can fit easily under the robot structure (air bags can be as thin as 0.7 inches thick). The invention pneumatics can control roll, pitch, and elevation of the robot by uniquely controlling inflating and exhausting of the four supporting air bags.

Other features and advantages of the invention will become apparent to those skilled in the art during the course of the following description.

Summary Of The Invention

My invention discloses a pressure selector joy stick type mechanism including a tiltable lever operator which includes axial motion (push and pull movement) as well. The lever tilting motion selectively actuates a first array of four valves providing machine control much the same as prior art joy stick pressure controllers. However my invention has connected to the lever a second cam actuator and two more arrays of four valves oriented parallel to and circular about the lever, and near the second cam actuator. Valves of the first parallel array actuate when the lever is pulled axially. Valves of the second parallel array actuate when the lever is pushed axially. As can be understood, the invention fluidic controller can operate more functions (has broader utility) when plumbed to machinery then do prior art pressure joy stick controllers: The invention lever operator can be tilted to control some machinery functions, and can be pulled to control other machinery functions, and can be pushed to control still other machinery functions.

Prior art pressure joy stick valves are limited to tilted only control of machinery, and must resort to (more complex and less intuitive) additional external valves to add additional machinery functional control.

My invention has an advantages of:

i. costing less than prior art pressure joy stick valves with added valve operators

ii. being more intuitive to control supported equipment pitch, roll, and elevation than prior art fluidic joy stick valves with added valve operators:

a. intuitive because as the single lever is tilted to left / right roll is controlled

b. intuitive because as the single lever is tilted forward / backward pitch is controlled

c. intuitive because as the single lever is pulled / pushed elevation is controlled

iv. being less costly, lighter weight, less complex, and thinner (to be positioned under machine structures) than are electric joy stick systems operating motorized jack screw positioners.

By way of example, my invention is illustrated herein by the accompanying drawing, wherein:

Drawing Figures

FIG. **1** is a perspective view of the pressurized fluid controller using tilt / push / pull operator.

FIG. **2** shows a fragmentary sectional elevation view taken as suggested by lines **2—2** of FIG. **1** with more detail shown of internal valve actuation and positioning.

FIG. **3** shows a transverse vertical section taken as suggested by lines **3—3** of FIG. **2** with more detail shown of internal valve actuation and positioning.

FIG. **4** shows a transverse vertical section taken as suggested by lines **4—4** of FIG. **2** with more detail shown of internal actuator positioning.

FIG. **5** shows a single pressure system schematic of the pressurized fluid controller using tilt / push / pull operator in association with pressurizable air bags and a heavy equipment supporting and positioning frame.

FIG. **6** shows a four pressure replaceable alternative embodiment of the single pressure system schematic of FIG. **5**.

FIG. **7** shows an added finger motion aid cage alternative embodiment of the pressurized fluid controller using tilt / push / pull operator.

Description Of The Preferred Emb diments

1. The Invention Pressurized Fluid Controller Using Tilt / Push / Pull Operator Preferred Embodiment in General

The view of FIG. **1** shows my invention "pressurized fluid controller using tilt / push / pull operator" referred to as numeral **25**. Assembly **25** includes a housing **10**, with four bores through which are attached four radial valves (three shown) **18a, 18b, 18c, 18d**. The housing **10** includes an additional four bores through which are attached four more valves (three shown) **23a, 23b, 23c, 23d** facing longitudinally in one direction. The housing **10** includes a final four bores through which are attached four final valves (three shown) **20a, 20b, 20c, 20d** facing in the opposite longitudinal direction.

FIG. **2** best shows confinement of a swivel joint (referred to as numeral **33**) within a spherical bore **11** in the housing **10**. A ball **13** with a through hole **14** is held within the spherical bore **11**. Through the hole **14** slips a lever **15** so it can be slideably pulled and pushed axially as well as tilted. Attached further along the lever **15** is an actuator **17**. At the opposite end of the lever **15** is a knob **16** facilitating easy finger movement of the lever **15**. Wherein, as the lever **15** is lifted or pulled axially, the actuator **17** actuates the valves **23a, 23b, 23c, 23d**. Wherein, as the lever **15** is pushed axially, the actuator **17** actuates the valves **20a, 20b, 20c, 20d.**

In FIG. **1**, one set of phantom lines shows the lever **15** and the knob **16** in the pulled out (axially extended) position. The other set of phantom lines show the lever **15** and the knob **16** in a tilted position. The solid line shows the lever **15** and the knob **16** in the neutral position occurring when all the valves **23a, 23b, 23c, 23d, 20a, 20b, 20c, 20d, 18a, 18b, 18c, 18d** are not actuated and valve return springs force the lever **15** and the knob **16** and the actuator **17** (shown in FIG. **2**) to this position.

FIG. **5** best shows that opening of the normally closed valves **23a, 23b, 23c, 23d** (by pulling the lever **15** upward) conveys pressurized fluid from a pressure supply **26** to an array of four air bags **27a, 27b, 27c, 27d.** The pressure supply **26** is shown encircled by "P". The air bags **27a, 27b, 27c, 27d** are shown sandwiched between an upper positioning frame **29** and a lower positioning frame **30.** As the air bags **27a, 27b, 27c, 27d** are pressurized, they elevate the upper positioning frame **29** and a heavy equipment **24** placed thereon.

As the lever **15** of FIG. **2** is depressed or pushed axially, the actuator **17** actuates simultaneously normally closed valves **20a, 20b, 20c, 20d**. FIG. **5** best shows that opening of the valves **20a, 20b, 20c, 20d** conveys pressurized fluid away from the four air bags **27a, 27b, 27c, 27d** to the atmosphere (exhausting). As the air bags **27a, 27b, 27c, 27d** exhaust, they lower the elevation of the upper positioning frame **29** and heavy equipment **24** thereon.

As the lever **15** shown in FIGS. **2** and **3** is tilted it actuates normally closed valves **18a, 18b, 18c, 18d** (individually or in close pairs). FIG. **5** best shows that tilting the lever **15** back opens the valve **18a** conveying pressurized fluid away from the air bag **27a** to the atmosphere (exhausting). As the air bag **27a** exhausts, it lowers the back of the upper positioning frame **29** and the heavy equipment **24**, thereby changing pitch in the back direction.

Tilting the lever **15** forward opens the valve **18b** which conveys pressurized fluid away from the air bag **27b** to the atmosphere (exhausting). As the air bag **27b** exhausts, it lowers the front of the upper positioning frame **29** and the heavy equipment **24**, thereby changing pitch in the forward direction.

Tilting the lever **15** to the right opens the valve **18d** which conveys pressurized fluid away from the air bag **27d** to the atmosphere (exhausting). As the air bag **27d** exhausts, it lowers the right side of the upper positioning frame **29** and the heavy equipment **24**, thereby changing roll in the right direction.

Tilting the lever **15** to the left opens the valve **18c** which conveys pressurized fluid away from the air bag **27c** to the atmosphere (exhausting). As the air bag **27c** exhausts, it lowers the left side of the upper positioning frame **29** and the heavy equipment **24**, thereby changing roll in the left direction.

Thus described is a preferred embodiment of the pressurized fluid controller using tilt / push / pull operator as used for adjusting roll, pitch, and elevation of the heavy equipment **24** supported by the four pressure air bags **27a, 27b, 27c, 27d**:

As the lever **15** is intuitively moved to the right, the heavy equipment **24** rolls to the right.

As the lever **15** is intuitively moved to the left, the heavy equipment **24** rolls to the left.

As the lever **15** is intuitively moved forward, the heavy equipment **24** pitches to the front.

As the lever **15** is intuitively moved backward, the heavy equipment **24** pitches to the back.

As the lever **15** is intuitively pulled upward axially, the heavy equipment **24** elevates or rises.

And, as the lever **15** is intuitively pushed downward axially, the heavy equipment **24** lowers.

Although not part of the assembly **25**, it can be helpful to mention a good methodology to position the equipment **24** (the lower positioning frame **30**) on a factory floor **32** as shown in FIG. **5**. So far description correctly has been limited only to the heavy equipment **24** pitch, roll, and elevation positioning. However, it is typical that workers operating the equipment **24** need to move the equipment **24** about the floor **32** so as to bring the equipment **24** in precision close position for docking or attachment to an additional machine. This floor **32** movement is most often

accomplished by attaching wheels under the lower positioning frame **30**. A wheel **31** is shown in FIG. **5**. Note that the wheel **31** to function is necessarily cantered and so can not make tiny XY positioning moves across the floor **32** well. If a worker moving the equipment **24** lines up the equipment **24** properly as to pitch, roll, and elevation, only to be unable to dock the equipment **24** with it's mating machinery because the wheel **31** will not cooperate and allow a simple 1/8 inch XY movement in floor direction then the docking operation can not be preformed! It is often a far better methodology to use air bearings under the lower positioning frame **30** than it is to use wheels to move the equipment **24**. An air bearing **28** is shown in FIG. **5**. In a real life application, the worker would not use both the wheel **31** and the air bearing **28** at the same time under the lower positioning frame **30**, but one of each is shown for explanatory reasons.

At best a good compete heavy equipment positioning system could include the four air bags **27a, 27b, 27c, 27d**, the assembly **25** (controlling pitch, roll, and elevation); and the four air bearings **28** allowing minute / unimpeded / omni directional / and near frictionless floor XY movement of the equipment **24**.

The assembly **25** described is capable of controlling the heavy equipment **24** pitch, roll, and elevation with worker one hand motion and in the most intuitive manner possible. Furthermore, the assembly **25** is robust, reliable, economical, versatile, and simple in construction. The assembly **25** completely controls the heavy equipment **24** pitch, roll, and elevation alignment for purposes such as docking or attachment to another piece of machinery without need to include additional valving, additional joy stick controllers, or introduce a complicated problematic electrical subsystem with additional switches.

2. Invention Construction Detail

More details of the assembly **25** operation and construction show in the views of FIGS. **2** and **3**. One construction of the housing **10** is machining out of metal or plastic in the shape of a square hollow tube near the knob **16** end. This shape easily allows for the drilling of four radial mounting holes to attach each of the four radial valves **18a, 18b, 18c, 18d** with a nut **19**. Each of the radial valves **18a, 18b, 18c, 18d** can have a short cap **22** attached to each valve stem to increase the valve stem contact surface with the lever **15** to a diameter slightly less than the lever **15** diameter. The caps **22** can be attached to the stems with set screws (not shown). The caps **22** increased area is beneficial as it allows the lever **15** to more easily engage the particular valve **18a, 18b, 18c, 18d** even if the lever's **15** approach angle is not exactly 90 degrees. The radial mounting hole location should be selected far enough away axially from the swivel joint **33** so the tilting movement of the

lever **15** in the plane of the valves **18a, 18b, 18c, 18d** about equals the valve stroke plus allowing about 1/16 inch clearance between the lever **15** and the attached valve cap **22.**

The opposite end of the housing **10** can be a round hollow thick disc in shape, with thin walls as best shown in the views of FIG. **4**, FIG. **3**, and FIG. **2**. This particular shape can accommodate easy axially attachment of each of the eight valves **23a, 23b, 23c, 23d, 20a, 20b, 20c, 20d** in eight mounting holes with the nut **19**. Also this housing **10** shape provides an axial cavity between the stem tips of the valves **23a, 23b, 23c, 23d**, and the stem tips of the valves **20a, 20b, 20c, 20d.** This axial cavity space can accommodate the actuator **17** . The actuator **17** can be attached to the lever **15** with a flat head screw (not shown). The internal length of the housing **10** cavity space should allow for the thickness of the actuator **17,** plus the stem noses of all the valves **23a, 23b, 23c, 23d, 20a, 20b, 20c, 20d,** plus a clearance of about 1/16 inch on each side of the actuator **17.**

The knob **16** can be attached to the lever **15** with a screw thread (not shown). All the valves **23a, 23b, 23c, 23d, 20a, 20b, 20c, 20d, 18a, 18b, 18c, 18d** can be of a common type: spring return, normally closed, threaded body mount, 2 way, poppet quick opening or spool type. Commercial valves that have proven to operate well within the assembly **25** include model CO30510 made by Pneumadyne Company of Plymouth, Minnesota, 55442. However, there are many commercially available similar models and types made by other commercial valve manufacturers that can work very well in this application.

The fitting type (connection to a pressurized conduit **21a, 21b, 21c, 21d**) throughout the system can be simple 10-32 gasket type barb tube fittings available in most hardware store outlets. The interconnecting conduits **21a, 21b, 21c, 21d** can be made from standard 1/8 inch inside diameter polyurethane tubing as the fluid flow rate for pressurized actuators is usually low and 1/8 inch diameter porting can function well in the system.

The swivel joint **33** best shown in FIG. **2** can be constructed of the spherical bore **11** in the housing **10** about equal in radius to the radius of the ball **13**. The spherical bore **11** should be just a little deeper than the ball **13** diameter. A thin disc shaped retainer plate **12** including a center clearance hole larger than the lever **15** diameter, and a series of mounting holes (not shown) for screw (not shown) attachment to the housing **10** can confine the ball **13** to proper swivel motion. The hole **14** through the ball **13** is just larger than the lever **15** diameter, so the lever **15** can move freely through the ball **13** in the axial direction. The lever **15** can be made of most metals with aluminum being an economical choice. A nylon swivel joint number 1071K14 sold by McMaster Carr

Company of Los Angeles, CA, 90054 can function well for the swivel joint **33** and includes the hole **14** as clearance for the lever **15**.

The actuator **17** can be made of a rigid material such as metal or plastic. A spherical disc shape for the actuator **17** can be advantageous as this shape matches the radius of the distance from the swivel joint **33** to the actuator **17**. With this shape, all portions of the actuator **17** will maintain a constant separation distance between valve stems of the valves **23a, 23b, 23c, 23d**, **20a, 20b, 20c, 20d** as the lever **15** tilts and as the actuator **17** moves from side to side within the housing **10** cavity. One practical diameter for the actuator **17** is about 2 inches, and a workable spherical radius of about 6 inches closely matches the shape of a commercially available frost plug model 550-028 made by Dorman Company of Colmar, PA 18915. The inside diameter of the housing **10** cavity near the actuator **17** should be significantly larger than the actuator **17** diameter so the actuator **17** motion is not impeded by the cavity wall as the actuator **17** moves about with the lever **15** tilting.

3. Alternate Embodiment ---Multiple Operating Pressures

The former preferred embodiment of the assembly **25** uses the single pressure supply **26** as shown in FIG. **5** to supply the filling valves **23a, 23b, 23c, 23d** which in turn inflate the air bags **27a, 27b, 27c, 27d** to elevate the equipment **24**. Realize that the heavy equipment **24** placed upon the upper positioning frame **29** must be exactly positioned and balanced with regard to weight distribution to the supporting air bags **27a, 27b, 27c, 27d** or the elevating (lifting) of the equipment **24** will be tipped or biased. In a real life application, exact balancing is most difficult to accomplish.

A second replaceable embodiment of the assembly **25** can easily and simply compensate for this uneven weight distribution problem.

Note that the solution to this unbalanced weight distribution problem is an unexpected and unobvious result of the assembly **25**. This solution evolved from awareness that the particular assembly **25** design includes four separate and independent pressurized subsystems: One subsystem comprises the valves **18a, 23a,** and **20a**, plumbed with the conduit **21a**, which controls fluid pressure within the air bag **27a**. A second subsystem comprises the valves **18b, 23b, 20b** plumbed with the conduit **21b**, which controls fluid pressure within the air bag **27b**. Similarly, there are two more independent pressure subsystems controlling the fluid pressure within the other air bags **27c** and **27d**.

Integrating this understanding that there can be four independent pressure subsystems (one for each supporting air bag) with anticipated problem that there can be times when the air pressure

elevating each of the four air bags **27a, 27b, 27c, 27d** needs to be different from the other pressures unexpectedly led to a solution: If a pressure regulator was added between the pressure supply **26** and each of the fill valves **23a, 23b, 23c, 23d**, then unbalanced equipment weight distribution can be compensated for by simple adjustment of pressure regulators supplying the four pressure subsystems.

FIG. **6** shows this alternate embodiment to the assembly **25** which is identical to the preferred embodiment shown in FIG. **5** except the new assembly referred to as numeral **25a** includes a set of four regulators **26a, 26b, 26c, 26d**. The regulators **26a, 26b, 26c, 26d** are plumbed in series between the pressure supply **26** and the four filling valves **23a, 23b, 23c, 23d**. The regulators **26a, 26b, 26c, 26d** can be simply attached to a bracket (not shown) bolted to the bottom of the housing **10**. The regulators **26a, 26b, 26c, 26d** are preferably of the self relieving type. Adjustment of the regulator **26a** controls the lift force available to the air bag **27a**. Adjustment of the regulator **26b** controls the lift force available to the air bag **27b,** and so forth. Using this unobvious embodiment of the assembly **25a**, the upper positioning frame **29** can evenly or perpendicularly elevate the equipment **24** even if the heavy equipment **24** weight is unevenly distributed upon the upper positioning frame **29**.

4. Alternate Embodiment ---Including a Finger Motion Aid Cage

FIG. **7** shows an alternate embodiment of the assembly **25** which includes addition of a finger motion aid cage referred to as numeral **38**. The finger motion aid cage **38** is constructed with a thin finger ring **37** secured to four finger supports **34a, 34b, 34c, 34d** with four rod welds **36**. The opposite ends of the finger supports **34a, 34b, 34c, 34d** each be attached to the housing **10** by press fitting into a corresponding rod bore **35**. The four finger supports **34a, 34b, 34c, 34d** are placed around the housing **10** such that the finger supports **34a, 34b, 34c, 34d** are spaced 90 degrees apart, near perpendicular to and on the axis of each of the valves **18a, 18b, 18c, 18d**. With this design, the worker operating the assembly **25** can easily and effortlessly use two or three fingers of one hand to squeeze the lever **15** toward the particular finger support **34a** or **34b** or **34c** or **34d** corresponding to the equipment **24** pitch or roll positioning change desired. Two finger operation is significant because such finger squeeze guarantees a perfect angular tilt of the lever **15** toward the proper valve **18a** or **18b** or **18c** or **18d** without disturbing or activating other valves unintentionally. Second, this finger squeeze takes minimal effort for the worker to perform well and can be held a long time in an activated position without discomfort or fatigue. Third, the finger

motion aid cage **38** forms a protective guard around the lever **15** and the knob **16** so that accidental activation cannot occur such as when something is bumped against or dropped on the assembly **25**. Using the finger motion aid cage **38**, the worker operating the assembly **25** can easily and effortlessly use two or three fingers of one hand (or palm and two fingers of one hand) to either pull or push the knob **16** as the equipment **24** elevation changes are desired. Such finger against palm squeeze takes minimal effort for the worker to perform, can be accomplished with one hand operation, and can be held for a long time in the activating position without discomfort or fatigue.

5. Alternate Embodiment ---Other Pneumatic Pressurized Positioners

The system of FIGS. **5** and **6** show how the assembly **25** interconnects to the air bags **27a, 27b, 27c, 27d** and varies the heavy equipment **24** pitch, roll, and elevation as the lever **15** is manipulated. It is important to note that other pressurized positioner devices can perform similar functions as the air bags **27a, 27b, 27c, 27d**. One such example (not shown) of alternate pressurized positioners are use of air cylinders and piston assemblies.

6. Alternate Embodiment ---Hydraulic Pressurized Positioners and Hydraulic Valves in the Assembly **25**

Although not intended, the forgoing embodiments may all have implied exclusively pneumatic components (e.g. air bags, air cylinders, etc.). Let it be understood that the valves **23a, 23b, 23c, 23d, 20a, 20b, 20c, 20d, 18a, 18b, 18c, 18d** in the assembly **25** could be hydraulic valves, the pressure supply **26** could be hydraulic, and the air bags **27a, 27b, 27c, 27d** could just as well be hydraulic cylinders (not shown).

7. Alternate Embodiment ---Hydraulic Pressurized Positioners and Pneumatic Valves Within the Assembly **25**

The described preferred embodiment of the assembly **25** can have all the valves **23a, 23b, 23c, 23d, 20a, 20b, 20c, 20d, 18a, 18b, 18c, 18d** pneumatic and the pneumatic pressure supply **26, but** still be used to control pitch, roll and elevation of the equipment **24** which is supported by hydraulic pressurized positioners, such as hydraulic cylinders (not shown). This pneumatic to hydraulic embodiment (not shown) would include simple addition of four pneumatic to hydraulic valves in series between each hydraulic pressurized positioners and each of the corresponding pneumatic output conduits **21a, 21b, 21c, 21d** of the assembly **25**. Such pneumatic to hydraulic valves are common and well known to those working in the hydraulic industry. In addition, the system described in this embodiment (although external to the assembly **25)** would include addition of a common hydraulic pressure system (not shown) to drive the hydraulic pressurized

positioners . An important observation to be made from this embodiment is that the assembly **25** can easily control pitch, roll, and elevation of the equipment **24** supported by hydraulic positioners as well as supported by pneumatic positioners.

8. Alternate Embodiment ---Valves Controlling Machinery Motion Other Than Pitch, Roll, and Elevation

The assembly **25** design allows for extra axially direction (pulling and pushing) valve actuation beyond that of other joy stick type operated pressurized controllers (which provide only tilting direction valve actuation). The previous embodiments all used the tilting valve control to vary the equipment **24** pitch and roll, and used the unique pull and push valve control to vary the equipment **24** elevation.

However, the assembly's **25** unique expanded valve design is capable of controlling other pressurized functions on machinery. For one example (not shown), the radial valves **18a, 18b, 18c, 18d** can control pressurized actuators attached to an automobile seat which slide the seat forward and backward and tilt the seat angle frontward or backward. In this example, the axial valves **23a, 23b, 23c, 23d, 20a, 20b, 20c, 20d** can control pressurized air bags attached to the seat which raise or lower the seat.

As another example (not shown), the radial valves **18a, 18b, 18c, 18d** can control air cylinders attached to a tractor plow which move the blade up and down and tilt the blade left or right. In this same example, the axial valves **23a, 23b, 23c, 23d, 20a, 20b, 20c, 20d** can control air motors attached to tractor drive wheels which move the tractor forward or backward.

The versatility of the assembly **25** beyond equipment pitch, roll, and elevation control is quite broad and is resultant from the assembly **25** design including the extra and very useful axial valve push and pull control beyond only the tilting valve control of other joy stick pressure controllers. One hand intuitive operation of a simple, single lever controller without need to activate additional electrical switches or activate additional valves opens countless new applications for the invention assembly **25** which are unexpected and unobvious.

9. Alternate Embodiment ---Alternate Valve Quantities (not shown)

All the drawings of the previous embodiments showed designs which include arrays of four valves. There is no reason why the three valve arrays can't include other quantities of valves such as one, two, three, eight, etc. For example , if only the equipment **24** pitch control is desired (with no roll control); then the first array of radial valves would only need the valves **18a** and **18b**. As another example, if the equipment **24** to be roll, pitch and elevation controlled is supported upon

air cylinders which include pilot actuated pressure dump valves, then the assembly **25** would need only the one valve **20a** in the bottom (third array) as the valve **20a** could be the pilot valve capable of dumping all four air cylinders thus lowering the equipment **24**.

9. Alternate Embodiment ---Alternate Two Valve Arrays Instead of Three Valve Arrays (not shown).

All the previous assembly **25** configurations used three valve arrays (first radial set operated by the lever **15** tilting, the second axial set operated by the lever **15** pulling, and the third axial set operated by the lever **15** pushing). However, the third valve **20a, 20b, 20c, 20d** array could be unnecessary if the second array of valves **23a, 23b, 23c, 23d** used three position valves instead of two position. When using three position valves, as the lever **15** is pushed, all the three position valves **23a, 23b, 23c, 23d** could shift to a position to exhaust all the air bags **27a, 27b, 27c, 27d** of FIG. **5** thus lowering the equipment **24**. Using three position valves, as the lever **15** is pulled, all the three position valves **23a, 23b, 23c, 23d** could shift to a position to fill all the air bags **27a, 27b, 27c, 27d** of FIG. **5** thus raising the equipment **24**. As can be seen, if array of the valves **23a, 23b, 23c, 23d** can control raising and lowering of the equipment **24**, then the third valve array **20a, 20b, 20c, 20d** can be eliminated.

For purposes of exemplification, particular embodiments of the invention have been shown and described to the best understanding thereof. However, other embodiments can include other radial valves types, other multiple axial valve types and arrangements activated by a lever operator as the lever operator is tilted, pulled, or pushed to accomplish a wide variety of pressurized actuator control, irrespective of particular structure configuration and materials without departing form the spirit and scope of the claimed invention.